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ELECTRO-OPTICAL SYSTEMS, INC. 125 N. VINEDO AVE. PASADENA, CALIFORNIA Mutual 4671

CODE-1
CR-52815

TRANSMITTAL OF PROGRESS REPORT

Date 5 November 1962

TO: Lewis Research Center
Space Electric Power Office
21000 Brookpark Road
Cleveland 35, Ohio
Attn: Mr. Gerald R. Brendel

[redacted]

Reference (Contract No.) NASA Contract NAS 3-2529 (NASA CR-52815; EOS-3410-ML-1)

Report No. 3410-ML-1	Date of Issue 1 Nov 1962
Short Title Vapor Thermionic Converters	Monthly Progress Report, Covers Period 27 Sept - 27 Oct 62
Classification U ~~XXXXXXXX~~	EOS Classified Doc. No.

Transmitted herewith are the required copies of the progress report described above. Fund and labor reports, if required, are included and distributed as tabulated below. Should additional information be desired, please direct your inquiries to the undersigned.

Very truly yours, A.O.

ELECTRO-OPTICAL SYSTEMS, INC.

J. G. Handley
Treasurer

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Monthly Progress Report
27 September - 27 October 1962

RESEARCH PROGRAM RELATED TO VAPOR THERMIONIC CONVERTERS FOR NUCLEAR APPLICATION

Prepared for

Lewis Research Center
Space Electric Power Office
21000 Brookpark Road
Cleveland 35, Ohio

Contract NAS3-2529

EOS Report 3410-ML-1 1 November 1962

Prepared by

A. O. Jensen
Principal Investigator

Approved by

J. Neustein
Manager
ADVANCED POWER SYSTEMS DIVISION

ELECTRO-OPTICAL SYSTEMS, INC. - PASADENA, CALIFORNIA

I PROGRAM STATUS

During the first monthly reporting period (September 27 - October 27) work has been initiated in four areas. These areas are:

1. Sample Standardization Investigations
2. Grain Growth Experiments
3. Emission Tests
4. Emission Microscope

In the following paragraphs we will briefly discuss the progress to date in each of the four areas outlined above.

1. Sample Standardization Investigations

2. Grain Growth Experiments

a. Discussion

We have discussed in detail, our material requirements with representatives of the Climax Molybdenum Company. Climax metallurgist, Mr. John V. Houston, reviewed for our benefit the basic steps in the production of ore to the rolling operations. After detailed discussions pertaining to the EOS material requirements and the Climax Company mill capability, Mr. Houston recommended that the specification of a given ASTM grain size after final vacuum anneal would undoubtedly be the most practical yardstick to use in order to achieve reproducible runs of material. Such a recommendation is quite different from the usual one wherein specification of tensile strength, hardness, and impurity content is considered adquate. We have accordingly used the recommended grain size criterion for one of our material specifications. The other criteria are purity and percentage reduction during rolling operations. We will receive the lowest carbon content material which is practically available.

Metallographic examination and spectrographic analysis after the final anneal will be used to provide final proof of material quality. We are advised that the carbon content of consumable electrode arc-melt molybdenum is between .010 percent and .015 percent, which is a high, but not intolerable, amount. We feel that resorting to exotic processes such as zone refining departs from the intent of the program which is to study the properties of molybdenum bar and sheet material of a practical form.

b. Summary

As a controlled starting point for our investigations we will receive from Climax Molybdenum Company annealed, recrystallized cross rolled plate, approximately .200 inch thick, with an average A.S.T.M. grain size of No. 3. The molybdenum will be unalloyed with minimum carbon and interstitial impurity content. We will receive a complete schedule of the treatment of the material from raw stock to finished plate. We will further receive photographic proof of grain size and a spectrographic analysis of the material after fabrication. We will thus start all our experiments from a controlled starting point. The specifications which we have set up in conjunction with the Climax Molybdenum Company are such that we should be able to get further runs of material with nearly identical properties.

3. Emission Tests

We are in the process of reducing the emission test vehicle design to shop drawings and are in the process of ordering materials for the fabrication of the devices.

4. Emission Microscope

a. Discussion

We have completed an examination of the literature of thermionic electron emission microscopes. We have reviewed our requirements for special items such as metal-gasketed vacuum flanges, vacuum view ports, hermetically sealed high voltage feed-throughs,

ceramic or quartz washers for electrode spacers, etc. We have decided on an electron lens system which is similar to that of Johannson's[1] because of its simplicity. Our lens system will be scaled up slightly to obtain a lower magnification in order to observe larger objects than Johannson did. Residual gases such as oxygen which readily react with hot Mo, may contaminate the material and in some cases may alter the sample surface crystal structure, due to thermal etching. In order to minimize oxygen contamination of the sample we plan to use a bakeable glass-metal system which will be evacuated with an ion pump. Thus, most of the reactive gases will be removed from the system before the heating of the Mo emitter begins. The molybdenum emitter will have received a high temperature outgassing prior to assembly in the emission microscope. Such techniques are in common use for obtaining ultra-high vacuum pressures (10^{-8} torr and lower) in a static system. Because we are dealing with a dynamic system, where the pressures in the vicinity of the hot Mo emitter may be higher than 10^{-8} torr, it is more realistic to speak of the need for ultra-high vacuum techniques in terms of reducing contamination to an experimentally insignificant amount rather than specify a particular pressure to be achieved.

b. Summary

We have completed a literature survey on electron emission microscopes and have selected a lens design for our electron emission microscope. We are in the process of reducing our designs to shop drawings. Orders are being placed for pertinent materials and components necessary for the fabrication of the microscope.

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[1] Johannson, H., "The Immersion Objective of Geometrical Electron Optics" Ann. Physik 21, pp. 274-284, November 1934

II PROGRAM FOR THE NEXT MONTHLY REPORTING PERIOD

In the next monthly report period our efforts will be directed to the following areas:

1. The acquistion of bar stock and rolled plate molybdenum for the grain growth and emission studies.
2. Reduction of emission test vehicle and grain growth study vehicle to shop drawings, the ordering of materials for these devices, and the start of fabrication.
3. Reduction of microscope design plans to shop drawings, the ordering of materials and the start of microscope fabrication.

III FINANCIAL STATUS

Man-hours, dollar expenditures, and commitments are submitted as a separate enclosure to this report.

IV PROGRESS DESCRIPTION

In view of our present status in the fulfillment of this program, we submit the amount of 5 percent as overall progress.

ELECTRO-OPTICAL SYSTEMS, INC. [illegible] PASADENA, CALIFORNIA

Contract NAS-3-2529

Status Report as of 27 October 1962:

	Expenditures To Date	remaining Balances
Hours:	313	10,187
Costs:	$ 4,156.00	$ 129,211
Commitments		none

By S. L. Kuhn
S. L. Kuhn
Assistant Controller

SLK:pg